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(54) DESHYDRATEUR D'AIR
(54) AIR DRYER

(57)

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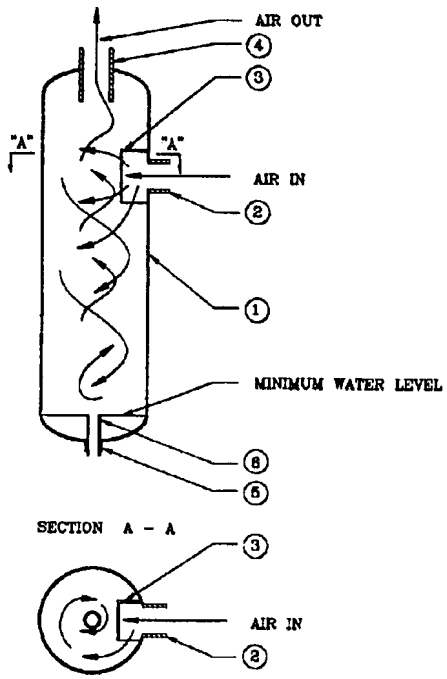

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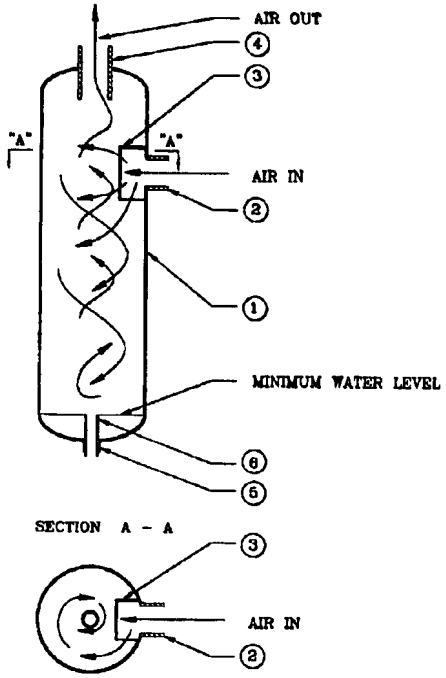
(54) Title: AIR DRYER



(57) Abrégé/Abstract:
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AIR DRYER

ABSTRACT

The present invention of an air dryer and a contaminant separator includes:

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SPECIFICATION

BACKGROUND OF THE INVENTION

Compressed air is typically used in paint spraying, for powering of pneumatic tools, such as pneumatic wrenches, sanders and grinders, for cleaning off of machinery, such as mills and lathes. Compressed air is further used to operate pneumatic actuators, motors, clutches and other industrial equipment. The air borne moisture and humidity entrapped within pneumatic installations tends to pass through the said equipment and corrode it in a due time, while solid particulate contaminants carried by the compressed air stream accelerate wear of friction parts in pneumatic equipment. Any water exiting the said power equipment is often quite undesirable, because it stains woodwork, contaminates spray paints and decreases efficiency and lifetime of sanding and polishing consumables.

Therefore, it is desirable to remove moisture and solid contaminants from compressed air before the said air enters any pneumatic equipment. It is also desirable to limit the compressed air humidity content before it enters the said equipment to such a degree, that the air expansion and cooling along with other pressure gradients within and past pneumatic tools and equipment do not cause further condensation and release of liquid water within, or past the said tools and equipment.

Compressed air dryers are well known devices. They can be classified as dehumidifiers and moisture separators.

Air dehumidifiers typically remove airborne water vapor by cooling the air stream below its dew point by means of refrigeration and removing the resulting condensation. This requires refrigeration systems. They tend to be relatively complex, expensive and need their own power supply. They have to be maintained, often requiring replacement of consumable parts. These are not related to the present invention.

Moisture separators typically remove only water, which is already present in the airlines in its liquid form. Most of these also remove to some degree solid particulate contaminants coming from the scaling of the airlines and other sources.

US Patent # 795750, Jul. 1905, Allington,
shows the principle of centrifugal removal of solid particulate from a turbulent air stream by means of a tangential entry of flow into a collecting vessel.

US Patent # 4325716, Apr. 1982, Livermore,
shows centrifugal collection of sludge by means of a tangential entry of flow into a vessel.

US Patent # 5746791, May 1998, Wang,
shows a turbulent collector of airborne mist and particulate contamination by means of a tangential entry of air flow into a vessel.

Canadian patent application # CA 2264156, Jun. 1998, Kamata,
shows a turbulent collector of airborne mist and solid particulate contamination by means of a radial entry of air flow into a vessel through a restricted cross section radial port inlet near the lower extremity of its upper vessel. The radial inflow is tangentially redirected into a vortex within the upper vessel by a baffle encapsulated on three sides, designed to create relatively high pressure at the baffle surface and a near ideal rising vortex pattern inside of the upper vessel. Canadian patent application # CA 2264156 further incorporates a secondary containing vessel below the collecting vessel complete with a drain port and a drain valve and a labyrinth facilitating separation and collection of liquid water in the upper portion of the upper collecting vessel.

DESCRIPTION

In the present invention, the air stream from a supply line (not shown) enters the dryer body (1) through the full cross section of an airline radial port inlet fitting (2) and impacts onto the baffle (3). The impact momentarily and locally compresses the air at the surface of the baffle (3) well above the designated, typically 110psi system pressure. This causes partial condensation of water vapor carried by the incoming air into liquid water mist at the baffle (3) surface. The said mist, along with any liquid water and solid particulate contaminants incoming by way of the supply line, is carried into the cavity of the body (1) and redirected into a helical flow within the said body by the integral baffle (3) encapsulation at one baffle (3) side and at the said baffle top.

The water mist and solid particulate is carried by centrifugal force toward the internal wall of the body (1) where the liquid water mist, as well as solid particulate contaminants become entrapped by adhesion upon contact with the said wall. The liquid water and the solid contaminants entrapped on the internal wall of the body (1) slide down into the lower collecting area of the body (1) by the action of gravity and by the action of the spiraling motion of the helical air flow periphery towards the lower extremity of the body (1).

The ratio of the length and diameter of the body (1), the height of the placement of the inlet fitting (2) within the body (1) and the bottom opening in the encapsulation of the impact baffle (3) as well as the baffle (3) shape assure creation of a helical pattern of the general vortex within the body (1) and progressive slow down of its orbital speed toward the lower extremity of the body (1). This assures that the collected liquid at the lower extremity of the body (1) is not excessively disturbed and that most of the liquid water and solid particulate present within the cavity of the body (1), whether adhering to the internal wall of the body (1) or still airborne, initially travel toward the lower extremity of the body (1). This allows for relatively long dwell time of the air within the body (1), assuring good rate of separation of liquid and solid contaminants from the air stream.

The water, or the sludge, collected in the lover extremity of the body (1) can be manually, or automatically, drained off through a valve (not shown) installed in the valve body (6). The valve body (6) is removably installed in the drain fitting (5), which allows for the valve body (6) removal and complete cleaning of the present invention dryer, if ever necessary. The valve body (6)

partially protrudes into the body (1), which maintains a minimum water level in the dryer after each draining. The minimum water level in the dryer assures that at least the lower portion of the internal wall of the dryer body (1) is always kept wet, which facilitates collection of solid particulate contaminants from the air stream.

The relatively dried and cleaned air spinning within the body (1) is forced toward the central vertical axis of the body (1), rises, and exits the dryer body (1) through the full line cross section port outlet fitting (4) in the said body upper extremity into the exhaust line (not shown). The internal extension of the outlet fitting (4) prevents the moist air on the periphery of the upper part of the air vortex at the upper extremity of the body (1) to be drawn into the outlet fitting (4) and consequently into the said exhaust line.

The preferable orientation of the dryer baffle (3) side opening and therefore the orientation of the helical vortex flow inside the dryer is clock wise looking from the top in the Northern Hemisphere (as shown) and counter clockwise looking from the top in the Southern Hemisphere.

CLAIMS

The present inventor has found out by observation and experiment that humidity can be extracted from a compressed air flow by an impact of the said flow onto a hard substrate, such as metal, as long as the said air stream has sufficient speed and a relatively free escape route from the substrate. He has utilized this observation in the design of the baffle (3).

The present inventor has found out by observation that while a consistent vortex in a stationary vessel collects any solid particulate at its center, a partially chaotic vortex centrifuges heavier than fluid particulate to its periphery. He has utilized this observation in the baffle (3) design, i.e. its shape and geometry ratios. The said design causes purposefully chaotic turbulence within the generally helical vortex flow within the cavity of the body (1) and a good characteristic of the consequential water mist and solid particulate contamination deposition on the internal wall of the body (1).

The present inventor has found out by reason that vortex flow in an enclosed cylindrical vessel can be made to spin as two concentric helixes, where the outer helix contacting the internal walls of the body (1) has progressively slowing speed in the downward direction from the baffle (3), while the internal helix of relatively dry and clean air has a progressively increasing orbital speed in the upward direction toward the outlet fitting (4). The present inventor has achieved this by the particular design of the baffle (3) and its placement within a vessel of particular proportions and utilized it for collection of liquid water mist and solid particulate contamination from compressed air flow at the lower extremity of the body (1).

The present inventor has utilized the well known capability of water to retain solid particulate by adhesion in his present invention by designing the valve body (6) so, that the said valve body maintains minimum water content within the present invention.

The present invention, although invented out of need for an affordable and dependable compressed air dryer is applicable, within its limitations of the necessary flow speed and degree of gas drying, to any gas flow drying.

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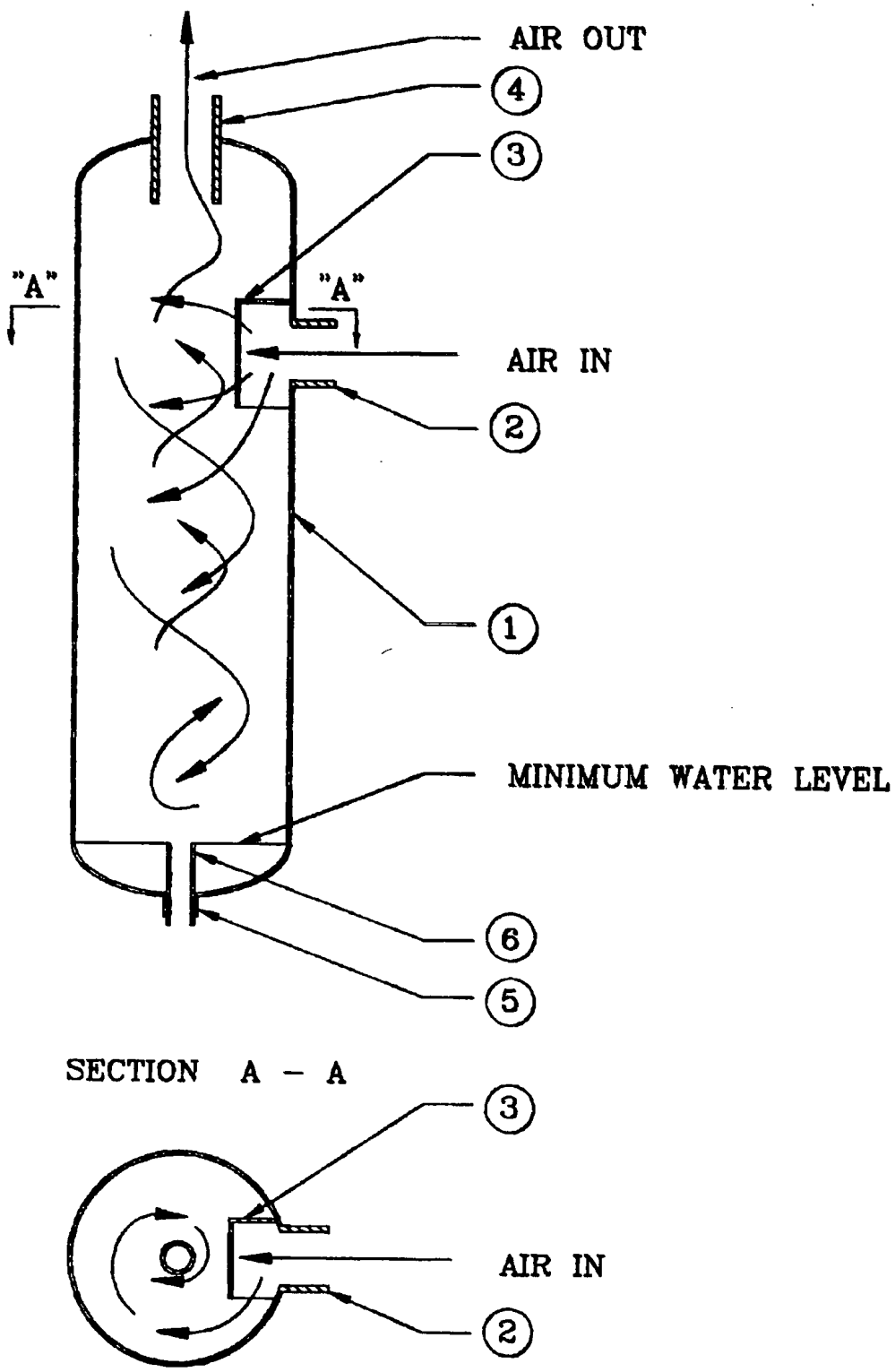
The present invention, although invented out of need for an affordable and dependable compressed air dryer is applicable, within its limitations of the necessary flow speed and degree of gas drying, to any gas flow drying.

The present invention depends heavily on pressure gradients and geometry and ratios of the present invention embodiment, therefore it depends on creation of an efficient turbulent pattern of air stream within the collecting vessel, i.e. body (1) rather than on a multitude of internal surfaces, orifices, labyrinths, secondary vessels and chambers, partitions and filters, which are inherent to the relevant previous art.

The present invention represents a very simple, but quite effective compressed air dryer, with low production cost, which is virtually maintenance free and which causes relatively small pressure drop in a pneumatic system. Six sealed prototypes of the present invention (under a non disclosure agreement) have been installed and tested under real ambient industrial conditions in Southern Ontario, with its high relative summer humidity. This has been done in cooperation with two manufacturers, who use compressed air driven power tools in their production process. The ongoing test has been in progress in excess of 12 years in one case and in excess of 2 years in the second case.

It has not been observed yet, that the present invention would allow any liquid water pas any continuous inflow compressed air driven power tools under any ambient relative humidity and temperature conditions.

Fig. 1


AIR OUT
4
3
"A"
"A"
AIR IN
2
1
MINIMUM WATER LEVEL
6
5
SECTION A – A
3
AIR IN
2